UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/059,176	01/31/2002	Hirokazu Hayashi	OKI.298	7695

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SAXENA, AKASH

ART UNIT	PAPER NUMBER
2128	

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

	Application No.	Applicant(s)
	10/059,176	HAYASHI, HIROKAZU
Office Action Summary	Examiner	Art Unit	
	Akash Saxena	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>28 November 2005</u>.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) <u>1-9</u> is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) <u>1-7</u> is/are rejected.

7)☒ Claim(s) <u>8 and 9</u> is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on <u>28 November 2005</u> is/are: a)☒ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some *   c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☐ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date <u>11/28/05</u>.

4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5)☐ Notice of Informal Patent Application (PTO-152)

6)☐ Other: _____ .

DETAILED ACTION

1. Claim(s) 1-9 has/have been presented for examination based on amendment filed on 28th November 2005.

2. Claim(s) 1, 5-7 are amended.

3. Claim(s) 8-9 are new claim(s) added with this amendment.

4. Previous non-final office action mailed on 26th July 2005 is incorporated within this office action unless otherwise specified where the more current rejection for the amended claims supercedes the previous rejection.

5. The arguments submitted by the applicant have been fully considered. Claims 1-9 remain rejected. The examiner's response is as follows.

Response to Applicant's Remarks & Examiner's Withdrawals

6. Acknowledgement for the foreign priority is denied until a certified translation of the Japanese Priority Application No. 2001-246268 is provided. Objection to specification related to essential subject matter is maintained likewise .

7. A signed copy of the IDS submitted on 31st January 2002 is attached with this office action.

8. Objections to the drawings are withdrawn in view of the new drawings submitted on 28th November 2005.

9. Correction to the abstract is acknowledged and objection to it is withdrawn likewise.

10. Objection to specification related use of phrase "mass of the said impurity" is maintained. Please also see 35 USC 112/2nd rejection below. Claim rejection related to claim 6 are withdrawn in view of the amendment & clarification.

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11. Double Patenting rejection is withdrawn in view of the arguments presented by the

applicant. However the prior art as claimed in considered to very close.

Response to Arguments for Claim Rejections - 35 USC § 112 & Specification

<u>Regarding Claim 1-7</u>

Examiner disagrees with the applicant that the term "mass of said impurity" is

appropriately used in the claim language. Merriam-Webster Online Dictionary

defines Mass and Density as:

> *Mass: the property of a body that is a measure of its inertia and that is commonly taken as a measure of the amount of material it contains and causes it to have weight in a gravitational field.*

> *Density: the quantity per unit volume, unit area, or unit length: as **a** <u>: the mass of a substance per unit volume</u> **b** : <u>the distribution of a quantity (as mass, electricity, or energy) per unit usually of space (as length, area, or volume).</u>*

The terminology used in the claim is misleading as to what is being observed, i.e.

change in the actual mass or a change in the density of the impurity in each cell.

Specification (Pg.12 Lines 19-26) discloses is delta C is change in the density.

Further, applicant argues that limitations not presented in the claim (Response Pg,

11 Second paragraph) – "impurity movement mass delta C (xi,yi)..." is not claimed,

but argues by the applicant. A clear terminology should be used to distinguish what

is being measured, as the impurity density [function] would give density at any one

point in (length, area or volume).

Applicant's arguments are found to be unpersuasive and Claim rejection for claim 1

and dependent claim is maintained.

<u>Regarding Claim 7</u>

Applicant has amended claim 7 however this still does not cure the deficiencies in claim 7. Claim 7 is still indefinite as what "other insulting layer" means is still unclear, as there are no other insulting layers beside the SiO2 layer (considered as insulting layer) disclosed. Examiner interprets the other insulting layer as SiO2 layer.

Under the above-mentioned interpretation, "disposing another a SiO2 layer opposite to SiO2 layer via Si layer" is indefinite.

Regarding Claim 8

Definitions of parameter lambda-1 and lambda-2 are vague and do not specify exactly which process dependent parameter is used to calculate distance functions.

Response to Applicant's Remarks for 35 U.S.C. § 103

Regarding Claim 1

Applicant has argued (Remarks: Pg 17 ¶2nd) that distances y and Leff do not

respectively correspond to distances r1 and r2, as would be necessary to meet the

features of claim 1. Examiner agrees with the applicant, however distances r1 and r2

as disclosed are another variation in looking at the relative position of the cell under

consideration and would have been obvious to one skilled in the art once presented

with the teachings of LI. Further, there are other possible variations like distance

from the gate or embedded biasing electrodes used in the MOSFET design to

correctly bias the N and P wells of the MOSFET.

Further, as argued y & Leff are merely as channel lengths, not related to the impurity

pileup portion and the cells or related to drain or source. Examiner disagrees, as

although stated as lengths, these are related to impurity pileup portion defined by the

terms Npile and Ns (LI: Pg.52 Eq. 1 & 2 & related text). Applicant's argument

regarding establishing a prima facie case of obviousness are considered and are

found to be unpersuasive.

Regarding Claim 2

Applicant argues that LI does not teach or disclose the limitations of claim 2 related

to distance r2. Examiner disagrees, as the distance r2 is distance from source or

drain from each cell, which can be expressed in terms of difference in position in x

and y co-ordinates and can be further related to the pile up concentrations N pile

function (See LI: Fig.1).

Regarding Claim 3

Applicant's argue that Kumashiro and Lim references do not teach "measuring distances in solid angle". Examiner agrees with the applicant that such teaching is not present in the two references above.

Comments relating to "impurity flux" are explained below. Merriam-Webster Online Dictionary defines Flux as:

> Flux: the rate of transfer of fluid, particles, or energy across a given surface.

Although the exact term "impurity flux" is not present in the claim in essentially, movement of "mass of impurity" considering each cell (as interface) is understood as impurity flux.

In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See In re McLaughlin, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

As Kumashiro & LI fail to teach solid angle for the movement of mass of said impurity as a function of solid angle, however teaching movement of mass across an interface (cell boundary – Specification: Fig.4) in another co-ordinate system based on distance and angular spread is well known in the art. Examiner takes "Official

Notice" that advantage of using solid angle are well known and expected in the art of

measurements. Definition of Solid Angle was provided in the previous office action

from Wolfram research/ Mathworld website. Merriam-Webster Online Dictionary

defines Solid angle as:

> *Solid Angle: the three-dimensional angular spread at the vertex of a cone measured by the area intercepted by the cone on a unit sphere whose center is the vertex of the cone.*

It would have been obvious to use solid angle as substitute co-ordinate system when

considering an interface (e.g. A cell boundary) instead of x-y coordinate system as it

would reduce the computational math to calculate differences between the two

values of x co-ordinates and y-coordinates.

Regarding Claim 5

Applicant argues that it is not even remotely suggested in prior art that position data

of multiple source and drain is set and then later on ignored selectively. This

limitation is a negative limitation, with no change in the end result as compared to

not setting individual drain and source positions data from the beginning. Hence the

claim 5 is obviously taught by the prior art.

Amended Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining

obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the

claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the

various claims was commonly owned at the time any inventions covered therein

were made absent any evidence to the contrary. Applicant is advised of the

obligation under 37 CFR 1.56 to point out the inventor and invention dates of each

claim that was not commonly owned at the time a later invention was made in order

for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35

U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

12. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,154,717 issued to Shingetaka Kumashiro (KU '717 hereafter), in view of Journal of Modeling and Simulation of Microsystems article "Physics-Based Threshold Voltage Modeling with Reverse Short Channel Effect" by K-Y Lim (LI 1999 hereafter).

Regarding Claim 1

KU '717 teaches (preamble & steps (a)(b)) a method of modeling semiconductor device process (KU '717: Col.1 Lines 7-14) by setting data for the SiO2 and Si layers brought in contact with each other (KU '717: Col.19 Lines47-48; Col.6 Lines 56-59). Further, KU '717 teaches (step (c)) setting plurality of cell in a layer (a mesh) with amount of impurity in each cell (KU '717: Col.19 Lines 52-57; Col.6 Lines 42-45). Further, KU '717 teaches (step (d) & (e)) setting diffusion rate on the impurities from one cell to another (KU '717: Col.19 Line 48) and setting up impurity pileup portion in a cell at the interface of SiO2 and Si (KU '717: Col.6 Lines 60-62).

Further, KU '717 teaches (step (g)) calculating the amount of impurity included in each cell after performing above-mentioned steps (KU '717: Col.6 Lines 63-64).

KU '717 does not teach step (f) explicitly.

LI 1999 teaches source and drain edges contributing to the reverse short channel effect and thus the affecting the impurities (LI 1999: Pg.52 Col.1 Lines 3-6). It would be obvious necessity to know the position of source and drain. *Further, LI 1999 teaches that the rate of diffusion for the impurities is shown to be function of two distances (LI 1999: Fig.1 Pg.52, Equation 1-2). LI teaches new limitations*

amended, i.e. "mass of impurity in each cell" (as effective pileup concentration)

determined by "impurity density function" (Fig.1) as a function of r1 and r2.

It would have been obvious to one (e.g. a designer) of ordinary skill in the art at

the time the invention was made to apply the teachings of **LI 1999** of **KU '717** to

create a model of semiconductor device. The motivation to combine would have

been that **KU '717** is simulating the impurity pileup in a semiconductor (KU '717:

Abstract) and LI 1999 teaches to model the cause of the impurity diffusion by

building joint vertical & lateral model for the phenomenon resulting from impurity

pileup (LI 1999: Pg.51, Col.1 Lines 12-21; Pg.56 Conclusion).

Regarding Claim 5

LI 1999 teaches considering the positions of source and drain as channel length and

then position relative to the cell as distance y from each of them. However, KU '717

teaches modeling a semiconductor without explicit knowledge of the position of the

source or drain (KU '717: Col.1 Lines 7-14). Combining these references will

effectively ignore the positions of specified drain(s).

Regarding Claim 6

LI 1999 teaches storing data for magnitude the reverse channel effect and

expressing the threshold voltage based on the impurity concentration (LI 1999:

Pg.52 Equations 1, 2, 3, 3(a), 3(b), 3 (c)). The amendment calculates the threshold

voltage using impurity amount calculated (i.e. Neff) from equation 3(c) specifically.

Regarding Claim 7

KU '717 teaches a method of modeling semiconductor device process (KU '717:

Col.1 Lines 7-14) by setting data for the SiO2 and Si layers brought in contact with

each other (KU '717: Col.19 Lines47-48; Col.6 Lines 56-59). Another insulting layer

is interpreted as SiO2 layer.

Allowable Subject Matter

<u>Regarding Claim 8-9</u>

Claims 8 & 9 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 8-9 are objected to as they present limitations not taught by either KU '717 or LI 1999. The functions r1 and r2 as exactly defined are found to be novel over prior art. The distances y and Leff are in the same direction and the r1 and r2 expressions are not multiplied by each other to yield the mass of impurity (Claim 9) by either KU '717 or LI 1999 combined. Further, there is no dependence shown based on the process parameters (lamda 1 & 2) other that Leff which is considered as a distance. <u>U.S. Patent No. 6,581,028 by inventor (Hayashi) & same assignee,</u> discloses similar exponential expressions for r1 and r2 (Fig.6), but the definitions of the terms x & y in the patent corresponding to r1 and r2 in instant application are different. X (distance from gate end in the direction of the channel length), y (distance from channel interface in the direction of channel depth) are different from r1 (distance from pileup position) and r2 (distance from source or drain). Also the terms are not multiplied together to obtain the mass of said impurity moving.

Effectively, if the independent claims of the current application are presented in the similar manner as Patent No. 6581028, expressly claiming the present invention in the equation format (Specification: Pg. 12Eq: 2), the claim may be allowable over prior art of record used.
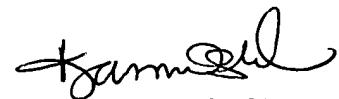
Communication

Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Akash Saxena whose telephone number is (571) 272-

8351. The examiner can normally be reached on 9:30 - 6:00 PM M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, Kamini S. Shah can be reached on (571)272-2279. The fax phone number

for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent

Application Information Retrieval (PAIR) system. Status information for published

applications may be obtained from either Private PAIR or Public PAIR. Status

information for unpublished applications is available through Private PAIR only. For

more information about the PAIR system, see http://pair-direct.uspto.gov. Should you

have questions on access to the Private PAIR system, contact the Electronic Business

Center (EBC) at 866-217-9197 (toll-free).

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